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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/676,182	09/30/2003	Steven Verhaverbeke	AMAT/8284/CMP/W-C/RKK	6792

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EXAMINER

CHAUDHRY, SAEED T

ART UNIT PAPER NUMBER

1746

DATE MAILED: 06/13/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/676,182	Applicant(s) VERHAVERBEKE, STEVEN	
	Examiner Saeed T. Chaudhry	Art Unit 1746	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 10 April 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5,9-14,17-20,24-30,34-38,40,42,43 and 45 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5,9-14,17-20,24-30,34-38,40,42 and 43 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on April 10, 2006 has been entered.

Claims 6-8, 15-16, 21-23, 31-33, 39 and 44 have been canceled and claims 1-5, 9-14, 17-20, 24-30, 34-38, 40-43 and 45 are pending in this application for consideration.

Claim Rejections - 35 USC § 112

Claims 1-5, 9-14, 17-20, 24-30, 34-38, 40-43 and 45 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 1, 14, 29 are indefinite and confusing in the recitation of "about 70% or less by weight of sulfuric acid and hydrofluoric acid" because it is not clear that is "70% or less" of sulfuric acid only or mixture of sulfuric acid and hydrofluoric acid.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. § 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

- (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
- (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
- (c) he has abandoned the invention.
- (d) the invention was first patented or caused to be patented, or was the subject of an inventor's certificate, by the applicant or his legal representatives or assigns in a foreign country prior to the date of the application for patent in this country on an application for patent or inventor's certificate filed more than twelve months before the filing of the application in the United States.

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(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

(f) he did not himself invent the subject matter sought to be patented.

(g) before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other.

Claims 1-2, 5, 9-12, 14, 20, and 24-27 are rejected under 35 U.S.C. 102(b) as being anticipated by Ramachandran et al (WO-02/10480).

Ramachandran et al (WO-10480) disclose a method of removing residue from a substrate. The etchant solution of the instant invention would also be useful for cleaning of many types of residue material. Residue materials include, but are not limited to oxygen, silicon; carbon and elements of an underlying conductive layer (see page 3, lines 11-14).

The present invention provides an etchant composition that is capable of removing via residue and does not adversely effect the aluminum lines or lines made of other conductive materials (See page 4, lines 16-19).

The etchant composition of the present invention is an aqueous solution containing about 0.01 to about 15 percent by weight of sulfuric acid, about 0.01 to about 20 percent by weight of hydrogen peroxide, or about 1 to about 30 ppm of ozone, and about 0.1 to about 100 ppm of hydrofluoric acid (see page 4, lines 23-27).

A preferred composition of the present invention is an aqueous solution of about 8 percent by weight of sulfuric acid, and about 1.5 percent by weight of hydrogen peroxide and the remainder being substantially water, and more preferably contain about 10 ppm of a fluoride containing compound, preferably hydrofluoric acid. This composition is preferably employed

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at temperatures of about 35 degree C. Another more preferred composition of the present invention is an aqueous solution of about 9 percent by weight sulfuric acid and about 4 percent by weight hydrogen peroxide and the remainder being substantially water, and more preferably contain about 10 ppm of a fluoride containing compound, preferably hydrofluoric acid. This composition is preferably employed at temperatures of about 35 degree C. and is especially preferred

for removing thicker and more tenacious sidewall polymer. Yet another more preferred composition of the present invention is an aqueous solution of about 5% by weight of sulfuric acid, about 12% by weight of hydrogen peroxide and about 10 ppm hydrogen fluoride. The water employed is preferably deionized water (see page 5, lines 23 through page 6, line4).

The etchants of the present invention can be used to contact the substrate where the polymer or via residue is to be removed by any known technique, such as dipping in a bath or preferably spraying the composition on the substrate or silicon wafer having the aluminum copper lines thereon.

Typically, the composition is sprayed at a temperature of about 25 to about 95.degree. C. and preferably at a temperature of about 30 to about 50.degree. C. for about 1 to about 8 minutes, typical of which is about 2 minutes. Following this, the wafer can be subjected to a deionized water rinse followed by drying (see page 7, line 18-25). Since the rinsing step is performed after the using an aqueous solution. Therefore, the rinse solution is inherently kept separated from the aqueous solution. Further, claims 1 and 14 include a recitation "about 70% or less by weight" and "about 3° C or less", which reads as 0% percent and 0° C temperature difference. Therefore, the claimed process is anticipated as claimed herein.

Claims 1-2, 5, 9-12, 14, 20, and 24-27 are rejected under 35 U.S.C. 102(e) as being anticipated by Rath et al.

Rath et al (6,630,074) disclose a method for removing residue from a substrate. The etchant solution of the instant invention would also be useful for cleaning of many types of residue material. Residue materials include, but are not limited to oxygen, silicon, carbon and elements of an underlying conductive layer (see col. 2, lines 38-43).

The present invention provides an etchant composition that is capable of removing via residue and does not adversely effect the aluminum lines or lines made of other conductive materials (See col. 3, lines 1-4).

The etchant composition of the present invention is an aqueous solution containing about 0.01 to about 15 percent by weight of sulfuric acid, about 0.01 to about 20 percent by weight of hydrogen peroxide, or about 1 to about 30 ppm of ozone, and about 0.1 to about 100 ppm of hydrofluoric acid (see col. 3, lines 12-18).

A preferred composition of the present invention is an aqueous solution of about 8 percent by weight of sulfuric acid, and about 1.5 percent by weight of hydrogen peroxide and the remainder being substantially water, and more preferably contain about 10 ppm of a fluoride containing compound, preferably hydrofluoric acid. This composition is preferably employed at temperatures of about 35.degree. C. Another more preferred composition of the present invention is an aqueous solution of about 9 percent by weight sulfuric acid and about 4 percent by weight hydrogen peroxide and the remainder being substantially water, and more preferably contain about 10 ppm of a fluoride containing compound, preferably hydrofluoric acid. This

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composition is preferably employed at temperatures of about 35.degree. C. and is especially preferred

for removing thicker and more tenacious sidewall polymer. Yet another more preferred composition of the present invention is an aqueous solution of about 5% by weight of sulfuric acid, about 12% by weight of hydrogen peroxide and about 10 ppm hydrogen fluoride. The water employed is preferably deionized water (see col. 3, line 54 through col. 4, line 7).

The etchants of the present invention can be used to contact the substrate where the polymer or via residue is to be removed by any known technique, such as dipping in a bath or preferably spraying the composition on the substrate or silicon wafer having the aluminum copper lines thereon.

Typically, the composition is sprayed at a temperature of about 25 to about 95.degree. C. and preferably at a temperature of about 30 to about 50.degree. C. for about 1 to about 8 minutes, typical of which is about 2 minutes. Following this, the wafer can be subjected to a deionized water rinse followed by drying (see col. 5, lines 9-19). Since the rinsing step is performed after the using an aqueous solution. Therefore, the rinse solution is inherently kept separated from the aqueous solution.

Further, claims 1 and 14 include a recitation "about 70% or less by weight" and "about 3° C or less", which reads as 0% percent and 0° C temperature difference. Therefore, the claimed process is anticipated as claimed herein.

Claims 1-2, 5, 9-12, 14, 20, 24-27, 38 and 43 are rejected under 35 U.S.C. 102(b) as being anticipated by Rath et al (EP-0918081).

Rath et al (EP-0918081) disclose a method for removing residue from a substrate. The etchant solution of the instant invention would also be useful for cleaning of many types of residue material. Residue materials include, but are not limited to oxygen, silicon, carbon and elements of an underlying conductive layer (see page 2, lines 48-50).

The present invention provides an etchant composition that is capable of removing via residue and does not adversely effect the aluminum lines or lines made of other conductive materials (See page 3, lines 6-7).

The etchant composition of the present invention is an aqueous solution containing about 0.01 to about 15 percent by weight of sulfuric acid, about 0.01 to about 20 percent by weight of hydrogen peroxide, or about 1 to about 30 ppm of ozone, and about 0.1 to about 100 ppm of hydrofluoric acid (see page 3, lines 11-13).

A preferred composition of the present invention is an aqueous solution of about 8 percent by weight of sulfuric acid, and about 1.5 percent by weight of hydrogen peroxide and the remainder being substantially water, and more preferably contain about 10 ppm of a fluoride containing compound, preferably hydrofluoric acid. This composition is preferably employed at temperatures of about 35.degree. C. Another more preferred composition of the present invention is an aqueous solution of about 9 percent by weight sulfuric acid and about 4 percent by weight hydrogen peroxide and the remainder being substantially water, and more preferably contain about 10 ppm of a fluoride containing compound, preferably hydrofluoric acid. This composition is preferably employed at temperatures of about 35.degree. C. and is especially preferred for removing thicker and more tenacious sidewall polymer. Yet another more preferred composition of the present invention is an aqueous solution of about 5% by weight of

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sulfuric acid, about 12% by weight of hydrogen peroxide and about 10 ppm hydrogen fluoride.

The water employed is preferably deionized water (see page 3, lines 32-42).

The etchants of the present invention can be used to contact the substrate where the polymer or via residue is to be removed by any known technique, such as dipping in a bath or preferably spraying the composition on the substrate or silicon wafer having the aluminum copper lines thereon. Typically, the composition is sprayed at a temperature of about 25 to about 95.degree. C. and preferably at a temperature of about 30 to about 50.degree. C. for about 1 to about 8 minutes, typical of which is about 2 minutes. Following this, the wafer can be subjected to a deionized water rinse followed by drying (see page 4, lines 20-25). Since the rinsing step is performed after the using an aqueous solution. Therefore, the rinse solution is inherently kept separated from the aqueous solution. Further, the cleaning solution and rinsing water are not recycled. Therefore, the solutions are inherently discarded after use.

Further, claims 1 and 14 include a recitation "about 70% or less by weight" and "about 3° C or less", which reads as 0% percent and 0° C temperature difference. Therefore, the claimed process is anticipated as claimed herein.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections

set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 1, 2, 5, 9-10, 14, 20, 24-25 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kuhn-Kuhnenfeld et al.

Kuhn-Kuhnenfeld et al (4,100,014) discloses a method of removing a residue from a substrate surface with an aqueous solution. According to the invention the aqueous solution is consisting of : (A) 1 TO 30, PREFERABLY 6 - 18% BY WEIGHT, OF HYDROFLUORIC ACID; (B) 2 TO 30, PREFERABLY 6 TO 20% BY WEIGHT, OF HYDROGEN PEROXIDE; (C) 1 TO 75, PREFERABLY 20 TO 55% BY WEIGHT, OF SULFURIC ACID; AND (D) 15 TO 95, PREFERABLY 30 TO 55% BY WEIGHT, OF WATER, Wherein the quantities of the individual components are so chosen that they will add up to a total of 100%.

The simplest manner to obtain the etching solutions is by the mixing of aqueous hydrofluoric acid and aqueous H₂O₂ of commercially-obtainable concentrations, and subsequent slow stirring of concentrated aqueous sulfuric acid, that is of about 98% by weight, into the mixture (see col. 1, lines 36-53).

Another composition of etching agent, which is also very suitable, and which has the advantage compared to the above-described solution that it is stable during a period of several days, consists of one part by volume of 40% by weight of hydrofluoric acid, four parts by volume of 30% by weight of aqueous hydrogen peroxide, and one part by volume of

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concentrated aqueous sulfuric acid of about 98% by weight, the latter being slowly poured into the solution. Since this etching agent contains considerably less sulfuric acid, it has to be heated first to about 80.degree.-100.degree. C, e.g., in a water bath, before being applied to gallium phosphide discs. The sawn or lapped wafer is then preferably hung in a plastic holding device in the etching solution and taken out again after five to ten minutes, rinsed with water, and dried (see col. 2, lines 21-35).

It would have been obvious at the time applicant invented the claimed process to manipulate the percentage of the hydrogen fluoride concentration of Kuhn-Kuhnenfeld et al or time for treatment and temperature for better and efficient results (see In re Aller et al., 105 USPQ 233, 42 CCPA 824). Since the rinsing step is performed after the using an aqueous solution. Therefore, the rinse solution is inherently kept separated from the aqueous solution. Further, the cleaning solution and rinsing water are not recycled. Therefore, the solutions are inherently discarded after use. Further, one of ordinary skill in the art would manipulate the percentages and temperature for mixing the solution for better and efficient results.

Claims 3-4, 17-19, 29-30, 34-35, 37, 40, 42-43 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rath et al or Ramachandran et al or Kuhn-Kuhnenfeld et al. in view of Gotoh et al.

Rath et al (U.S. patent 6, 630,074 or EP-0918081), Ramachandran (WO-02/10480) and Kuhn-Kuhnenfeld et al were discussed supra. However, the references fail to use surfactant in the cleaning solution.

Gotoh et al (5,650,041) disclose a method for removing residue from a substrate surface with a cleaning solution comprising hydrofluoric acid and surfactant. Wherein the surfactant is based on the glycol ether or ester and the concentration of the surfactant in the cleaning solution is 100 ppm (see col. 7, lines 7-11 and 51-57).

It would have been obvious at the time applicant invented the claimed process to incorporate a surfactant in the cleaning solution of Rath et al or Ramachandran et al or Kuhn-Kuhnenfeld et al since the surfactants are well known to reduce the surface tension and increase the wet ability of the substrate. Further, one of ordinary skill in the art would manipulate the percentages and temperature for mixing the solution for better and efficient results.

Furthermore, claim 29 include a limitation “about 70% or less by weight” and “about 3° C or less”, which is read as 0% percent and 0° C temperature difference. Furthermore, producing the cleaning solution which has 1-15% hydrogen peroxide, 1-10% sulfuric acid, 10-1000 ppm hydrogen fluoride and a surfactant at 1,000 ppm is equivalent to any cleaning solution having the same percentages even though they are produced by any other processes such as mixing with different percentage products. The final product solution which is used for removing the residue would have not given any other or different results since the properties of the same percentage cleaning solution would not be changed by how the product is produced.

Claims having limitations 67% of sulfuric acid and 0.4% hydrogen peroxide and 0.1% of surfactant would have been obvious to manipulate the percentages with routine experimentation to produce final product, which is disclosed by the cited prior art and has been used for cleaning and removing residue form the surfaces.

Claims 13, 28 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rath et al or Ramachandran et al in view of Oonishi et al.

Rath et al (U.S. patent 6, 630,074 or EP-0918081) and Ramachandran (WO-02/10480) were discussed supra. However, the references fail to use sonication.

Oonishi et al (6,273,959) disclose a method for cleaning semiconductor device by contacting the semiconductor with a cleaning solution containing 24 wt. % sulfuric acid, 5 wt % hydrogen peroxide, 0.02 wt % hydrogen fluoride, 0.075 wt % n-dodecyl-benzenesulfonic acid and water. The semiconductor is immersed into the cleaning solution for 10 minutes and thereafter semiconductor is subjected to overflow water rinsing for 7 minutes. While the semiconductor is simply immersed in the cleaning solution, other known techniques may be employed in combination with the immersion such as megasonic technique utilizing ultrasonic (see col. 4, lines 10-51 and col. 5, lines 60-65).

It would have been obvious at the time applicant invented the claimed process to incorporate the cited steps of sonication as disclosed by Oonishi et al into the process of Rath et al or Ramachandran et al or Kuhn-Kuhnenfeld et al to enhance the removal effect with the sonication.

Response to Applicant's arguments

The applicant argued that Ramachandran et al., Rath et al, '074, Rath et al. '081 and Kuhn-Kuhnenfeld et al. do not teach, show or suggest an aqueous solution including about 67% by weight of sulfuric acid and about 0.4% by weight of hydrofluoric acid, as recited in claims 1,14 and claims dependent thereon.

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This argument is not persuasive because claims 1 and 14 do not requires these limitations. Further, dependent claims having these limitations do not provide different results since the cleaning solution which is used for cleaning is disclosed by the cited prior art and by diluting the intermediate solution to from a cleaning solution would not effect the process of cleaning or removing residue from a substrate surface.

Applicant's arguments with respect to claims 1-5, 9-14, 17-20, 24-30, 34-38, 40, 42-3 and 45 have been considered but are moot in view of the new ground(s) of rejection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Saeed T. Chaudhry whose telephone number is (571) 272-1298. The examiner can normally be reached on Monday-Friday from 9:30 A.M. to 4:00 P.M.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mr. Michael Barr, can be reached on (571)-272-1414. The fax phone number for non-final is (703)-872-9306.

When filing a FAX in Gp 1700, please indicate in the Header (upper right) "Official" for papers that are to be entered into the file, and "Unofficial" for draft documents and other communication with the PTO that are for entry into the file of the application. This will expedite processing of your papers.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (571) 272-1700.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Saeed T. Chaudhry
Patent Examiner

MICHAEL BARR
SUPERVISORY PATENT EXAMINER

A handwritten signature in dark ink, appearing to read 'Michael Barr', is written over a horizontal line.